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(54) Hitch device for attaching farm implements to a tractor and associated hydraulic circuit

(57) A farm implement of a tractor (2) is hitched to two lift arms (3), each of which is moved by a respective actuating cylinder (5) having two chambers (27a, 27b) connected to a feed circuit (13) supplying a pressurized fluid; the feed circuit (13) having, for each chamber (27a, 27b), two feed lines (28, 29) for feeding the fluid to and from the chamber (27a, 27b) respectively, and four independent valves (33, 34), each located along one of the feed lines (28, 29) and movable between a closed position and at least one open position respectively closing and opening the relative feed line (28, 29).

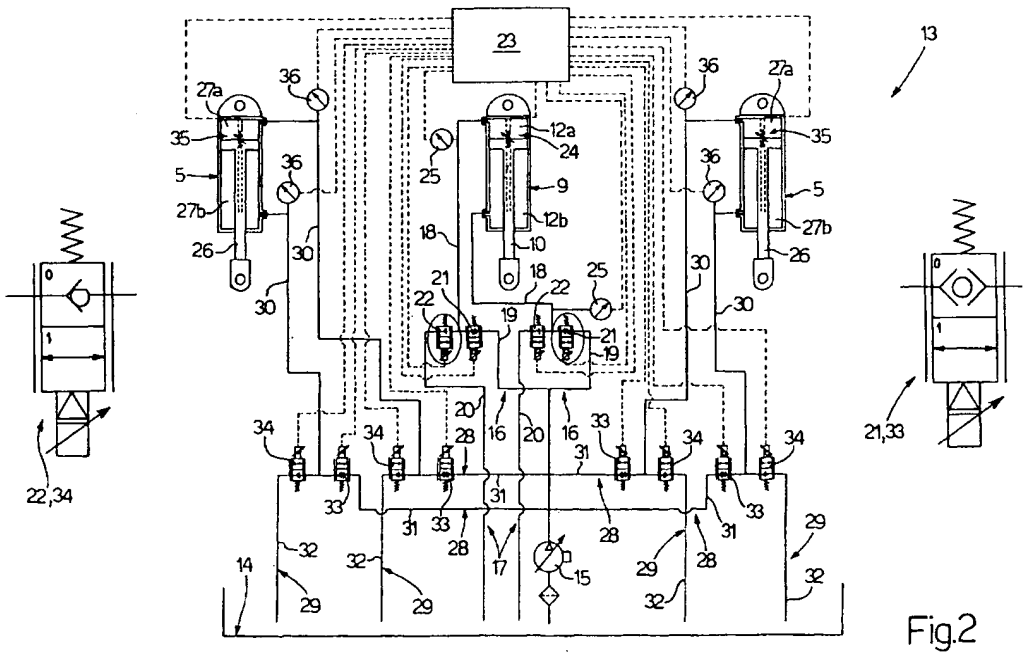

Fig.2

EP 1 403 102 A1

Description

[0001] The present invention relates to a hitch device for attaching farm implements to a tractor.

[0002] More specifically, the present invention relates to a so-called "three-point hitch device", to which the following description refers purely by way of example.

[0003] In the farm machinery industry, a three-point hitch device is known for attaching farm implements to a tractor. Such hitch device typically comprises two bottom lift arms, to which the implement is connected in rotary manner to oscillate about a given hinge axis and a top actuating cylinder interconnected between the tractor frame and the implement to control the angular position of the implement about the hinge axis.

[0004] Each lift arm is moved by a further actuating cylinder interposed between the tractor frame and the lift arm itself. Each cylinder has an output rod defining, inside said cylinder, two chambers, each of which is connected to a feed line of a hydraulic circuit supplying pressurized fluid to and from the chambers.

[0005] The hydraulic circuit comprises a slide valve located along the feed lines and movable selectively between a closed position and three open positions closing and opening the respective feed lines. In two of the open positions, one of the two feed lines communicates hydraulically with a pump supplying fluid to the relative chamber, and the other communicates hydraulically with a fluid tank; and, in the third open position, both feed lines communicate hydraulically with the tank.

[0006] The hydraulic circuit further comprises a lock valve interposed between the feed lines and relative chambers to keep the output rod in a given position when the slide valve is in the closed position.

[0007] A major drawback of known hitch devices of the above type is that, when the slide valve is moved to the third open position, the lock valve must be operated to connect both chambers hydraulically to the tank. Moreover, operation of the lock valve is relatively complex and not very precise.

[0008] It is an object of the present invention to provide a hitch device for attaching farm implements to a tractor, designed to eliminate the aforementioned drawbacks.

[0009] According to the present invention, there is provided a hitch device for attaching farm implements to a tractor, the device comprising two lift arms for supporting at least one farm implement; an actuating cylinder for each lift arm, the actuating cylinder having an output rod defining two chambers inside the actuating cylinder; and a circuit for feeding a fluid to and from said chambers; characterized in that said circuit comprises, for each said chamber, two feed lines for feeding said fluid to and from the chamber respectively, and also comprises four independent valves; each valve being located along one of said feed lines, and being movable between a closed position and at least one open position respectively closing and opening the relative said feed line.

[0010] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic view in perspective of a preferred embodiment of the hitch device according to the present invention;

Figure 2 shows schematically, with parts enlarged for clarity, a hydraulic circuit employed in the Figure 1 hitch device;

Figure 3 shows a first alternative embodiment of the Figure 2 hydraulic circuit; and

Figure 4 shows a second alternative embodiment of the Figure 2 hydraulic circuit.

[0011] Number 1 in Figure 1 indicates as a whole a hitch device for attaching a known farm implement (not shown), such as a plough, to a tractor 2.

[0012] Device 1 is normally referred to as a "three-point hitch device", and comprises two bottom lift arms 3, which are connected in rotary manner to a frame 4 of tractor 2 by the interposition, for example, of a spherical joint (not shown). The lift arms 3 are oscillated, with respect to frame 4 and by respective actuating cylinders 5, about respective substantially horizontal axes 6 of rotation (only one shown in Figure 1).

[0013] The free end of each arm 3 has a supporting hook 7, which co-operates with hook 7 of the other arm 3 to support the implement (not shown). The implement is connected in rotary manner to the hooks 7 to oscillate, with respect to hooks 7, about a hinge axis 8. The angular position of the implement about axis 8 is controlled by a top actuating cylinder 9, which is connected in rotary manner to frame 4 by means of, for example, a spherical joint (not shown), and comprises an output rod 10, the free end of which has a supporting hook 11 for engaging the implement.

[0014] With reference to Figure 2, rod 10 defines, inside cylinder 9, two chambers 12, which communicate hydraulically with a hydraulic circuit 13 supplying pressurized fluid to the chambers. One of the chambers (hereinafter indicated 12a) has a larger cross section than the other chamber (hereinafter indicated 12b) as a result of the presence of the rod 10.

[0015] Circuit 13 comprises a fluid tank 14 and a feed pump 15 - in the example shown, a known piston pump - for drawing fluid from tank 14. For each chamber 12a, 12b, two feed lines 16, 17 are provided for feeding fluid respectively to and from chamber 12a, 12b. Lines 16, 17 of each chamber 12a, 12b comprise a portion 18 common to both lines 16, 17 and connected hydraulically to a respective chamber 12a, 12b and two respective portions 19, 20. Portion 19 is a feed portion connected hydraulically to pump 15, and portion 20 is a drain portion connected hydraulically to tank 14.

[0016] Each portion 19, 20 also communicates hydraulically with relative portion 18 through a proportional

electromagnetic valve 21, 22, which is movable, under the control of an electronic central control unit 23, between a closed position (hereinafter indicated "O") closing relative portion 19, 20, and an open position (hereinafter indicated "I") opening relative portion 19, 20.

[0017] In actual use, central control unit 23 selectively controls valves 21, 22 of cylinder 9 independently, so that:

when valves 21, 22 of chamber 12a are in the open "I" and closed "O" position respectively, and valves 21, 22 of chamber 12b are in the closed "O" and open "I" position respectively, chamber 12a communicates with the pump 15 and chamber 12b communicates with the tank 14, whereby rod 10 of cylinder 9 moves from a withdrawn position to an extracted position;

when valves 21, 22 of chamber 12a are in the closed "O" and open "I" position respectively, and valves 21, 22 of chamber 12b are in the open "I" and closed "O" position respectively, chamber 12a communicates with the tank 14 and chamber 12b communicates with the pump 15, whereby rod 10 of cylinder 9 moves from the extracted position to the withdrawn position; and

when valves 21, 22 of chamber 12a are in the closed "O" and open "I" position respectively, and valves 21, 22 of chamber 12b are also in the closed "O" and open "I" position respectively, both chambers 12a, 12b communicate with tank 14, and rod 10 of cylinder 9 floats as determined by the loads imposed thereon by the farm implement.

[0018] Cylinder 9 further comprises a detecting device 24 connected to the central control unit 23 for controlling the position of rod 10 along cylinder 9. Two pressure transducers 25 additionally are associated with cylinder 9 and are also connected to central control unit 23 for determining the pressure in respective chambers 12a, 12b and, therefore, the force exerted in use on rod 10.

[0019] In actual use, central control unit 23 selectively controls operation of all the valves 21, 22 of cylinder 9 as a function of the signals from device 24 and/or transducers 25, so as to operate cylinder 9 as follows:

when central control unit 23 only takes into account the signals from device 24, and excludes the signals from transducers 25, valves 21, 22 of cylinder 9 are operated to move rod 10 into, and then maintain, a given position stored in central control unit 23;

when central control unit 23 only takes into account the signals from transducers 25, and excludes the signals from device 24, valves 21, 22 of cylinder 9 are operated to move rod 10 so that the force exerted on rod 10 by the implement (not shown) is maintained substantially constant and equal to a given value; and

when central control unit 23 takes into account the signals from both device 24 and transducers 25, valves 21, 22 of cylinder 9 are operated to move rod 10 within a given range of positions stored in central control unit 23, and to keep the force exerted on rod 10 by the implement (not shown) substantially constant and equal to a given value.

[0020] Each cylinder 5 is connected in rotary manner to frame 4 by the interposition, for example, of a spherical joint (not shown), and comprises an output rod 26. At its free end, each rod 26 is connected in articulated manner to a corresponding arm 3. The rod 26 defines, inside cylinder 5, two chambers 27 communicating hydraulically with circuit 13. One of the chambers (hereinafter indicated 27a) has a larger cross section than the other chamber (hereinafter indicated 27b) as a result of the presence of the rod 26.

[0021] For each chamber 27a, 27b of each cylinder 5, circuit 13 comprises two feed lines 28, 29 for feeding fluid respectively to and from the chamber 27a, 27b. Lines 28, 29 of each chamber 27a, 27b comprise a portion 30 common to both lines 28, 29 and connected hydraulically to a respective chamber 27a, 27b. The lines 28, 29 further comprise two respective portions 31, 32, of which portion 31 is a feed portion connected hydraulically to pump 15, and portion 32 is a drain portion connected hydraulically to tank 14.

[0022] Each portion 31, 32 also communicates hydraulically with relative portion 30 through a proportional electromagnetic valve 33, 34, which is movable, under the control of central control unit 23, between a closed position (hereinafter indicated "O") closing relative portion 31, 32, and an open position (hereinafter indicated "I") opening relative portion 31, 32.

[0023] Each cylinder 5 further comprises a detecting device 35 connected to central control unit 23 for controlling the position of rod 26 along cylinder 5; and two pressure transducers 36 also connected to central control unit 23 for determining the pressure in respective chambers 27a, 27b and, therefore, the force exerted in use on rod 26.

[0024] Valves 33, 34 of each cylinder 5 operate in exactly the same way as described for valves 21, 22 of cylinder 9, and therefore require no further explanation.

[0025] In connection with the above, it should be pointed out that:

- the implement is lowered when the rods 26 are moved simultaneously from the withdrawn to the extracted position;
- the implement is raised when the rods 26 are moved simultaneously from the extracted to the withdrawn position;
- the implement is maintained in a given position when the valves 33, 34 of cylinders 5 are all in the closed "O" position;
- the implement is moved about an axis of oscillation

(not shown) substantially perpendicular to axis 8, when one of the rods 26 is maintained in a given position and the other is moved between the withdrawn and extracted positions, and also when one of the rods 26 is moved from the withdrawn to the extracted position, and the other one from the extracted to the withdrawn position;

- the implement floats freely relative to the ground when the valves 34 are all in the open "I" position, and the valves 33 are all in the closed "O" position; and
- the angular position of the implement about axis 8 is controlled selectively by operation of cylinder 9.

[0026] The Figure 3 embodiment differs from Figure 2 solely by the piston pump 15 being replaced by a feed assembly 37 comprising a gear pump 38 for drawing fluid from tank 14; a drain line 39 for draining pump 38 into tank 14; and a compensating valve 40, which is located along line 39, is normally set to an open position opening line 39, and is moved by central control unit 23 into a closed position closing line 39 when fluid is to be fed by pump 38 to valves 21 and/or 33.

[0027] The Figure 4 embodiment differs from Figures 2 and 3 solely by piston pump 15 and feed assembly 37 being replaced by a feed assembly 41 comprising a piston pump 42 for drawing fluid from tank 14; a gear pump 43 also for drawing fluid from tank 14; a drain line 44 for draining pump 43 into tank 14; and a connecting line 45 connecting pumps 42 and 43.

[0028] Assembly 41 further comprises a compensating valve 46 located along line 45 and normally set to a closed position closing line 45; and a drain valve 47 located along line 44 and normally set to an open position opening line 44. In actual use, when fluid is to be fed by pump 42 to valves 21 and/or 33, central control unit 23 moves valve 46 into an open position opening line 45, so that pump 43 supplies fluid to pump 42, and valve 47 is moved into a closed position closing line 44.

[0029] The pressure transducers 36 provide for directly controlling the forces exerted, in use, on hitch device 1, with no need for additional control devices specially designed for the purpose. In this connection, it should be pointed out that pressure transducers 25 are auxiliary with respect to pressure transducers 36.

Claims

1. A hitch device for attaching farm implements to a tractor (2), the device comprising :

   - two lift arms (3) for supporting at least one farm implement;
   - an actuating cylinder (5) for each lift arm (3), the actuating cylinder (5) having an output rod (26) defining two chambers (27a, 27b) inside the actuating cylinder (5); and
   - a circuit (13) for feeding a fluid to and from said chambers (27a, 27b); and

   characterized in that said circuit (13) comprises, for each said chamber (27a, 27b) , two feed lines (28, 29) for feeding said fluid to and from the chamber (27a, 27b) respectively, and also comprises four independent valves (33, 34); each valve (33, 34) being located along one of said feed lines (28, 29), and being movable between a closed position and at least one open position respectively closing and opening the relative said feed line (28, 29).

2. A device according to claim 1, **characterized in that** each said valve (33, 34) is a proportional electromagnetic valve.

3. A device according to claim 1 or 2, **characterized in that** said actuating cylinder (5) has a first detecting device (36) for detecting a fluid pressure inside each of said chambers (27a, 27b) to determine a force exerted, in use, on said output rod (26); electronic control means (23) being provided to selectively control said valves (33, 34) as a function of a signal from said first detecting device (36) .

4. A device according to any of the preceding claims, **characterized in that** said actuating cylinder (5) has a second detecting device (35) for detecting a position of said output rod (26) along the actuating cylinder (5); electronic control means (23) being provided to selectively control said valves (33, 34) as a function of a signal from said second detecting device (35) .

5. A device according to any of the preceding claims, **characterized in that** said actuating cylinder (5) has a first detecting device (36) for detecting a fluid pressure inside each of said chambers (27a, 27b) to determine a force exerted, in use, on said output rod (26) and a second detecting device (35) for detecting a position of said output rod (26) along the actuating cylinder (5); electronic control means (23) being provided to selectively control said valves (33, 34) as a function of a signal from said first and/or said second detecting device (36, 35).

6. A device according to any of the preceding claims, **characterized in that** said farm implement is connected in rotary manner to said lift arms (3) to oscillate about a given hinge axis (8); a further actuating cylinder (9) being interposed between the tractor (2) and the farm implement to selectively control an angular position of the farm implement about said hinge axis (8).

7. A device according to claim 6, **characterized in that** said further actuating cylinder (9) comprises a

further output rod (10) defining two further chambers (12a, 12b) inside the further actuating cylinder (9); said circuit (13) also comprising two further feed lines (16, 17) for feeding said fluid to and from each said further chamber (12a, 12b) respectively, and four independent further valves (21, 22), each located along one of said further feed lines (16, 17) and movable between a closed position and at least one open position respectively closing and opening the respective said further feed line (16, 17).

8. A device according to claim 7, **characterized in that** each said further valve (21, 22) is a proportional electromagnetic valve.

9. A device according to claim 7 or 8, **characterized in that** said further actuating cylinder (9) has a third detecting device (25) for detecting a fluid pressure inside each of said further chambers (12a, 12b) to determine a force exerted, in use, on said further output rod (10) ; electronic control means (23) being provided to selectively control said further valves (21, 22) as a function of a signal from said third detecting device (25) .

10. A device according to any of the claims 7 to 9, **characterized in that** said further actuating cylinder (9) has a fourth detecting device (24) for detecting a position of said further output rod (10) along the further actuating cylinder (9); electronic control means (23) being provided to selectively control said further valves (21, 22) as a function of a signal from said fourth detecting device (24).

11. A device according to any of the claims 7 to 10, **characterized in that** said further actuating cylinder (9) has a third detecting device (25) for detecting a fluid pressure inside each of said further chambers (12a, 12b) to determine a force exerted, in use, on said further output rod (10) and a fourth detecting device (24) for detecting a position of said further output rod (10) along the further actuating cylinder (9); electronic control means (23) being provided to selectively control said further valves (21, 22) as a function of a signal from said third and/or said fourth detecting device (25, 24) .

12. A device according to any of the preceding claims, **characterized in that** said circuit (13) comprises a piston pump (15) .

13. A device according to any of the claims 1 to 11, **characterized in that** said circuit (13) comprises a feed assembly (37), in turn comprising a tank (14) for said fluid; a gear pump (38) for drawing fluid from said tank (14); a drain line (39) for draining the gear pump (38) into the tank (14); and a compensating valve (40) located along said drain line (39) and movable between an open position and a closed position respectively opening and closing the drain line (39).

14. A device according to any of the claims 1 to 11, **characterized in that** said circuit (13) comprises a feed assembly (41), in turn comprising a tank (14) for said fluid; a piston pump (42) and a gear pump (43) for drawing fluid from said tank (14); a drain line (44) for draining the gear pump (43) into the tank (14); a drain valve (47) located along said drain line (44) and movable between an open position and a closed position respectively opening and closing the drain line (44); a connecting line (45) connecting said piston pump and said gear pump (42, 43); and a compensating valve (46) located along said connecting line (45) and movable between an open position and a closed position respectively opening and closing the connecting line (45).

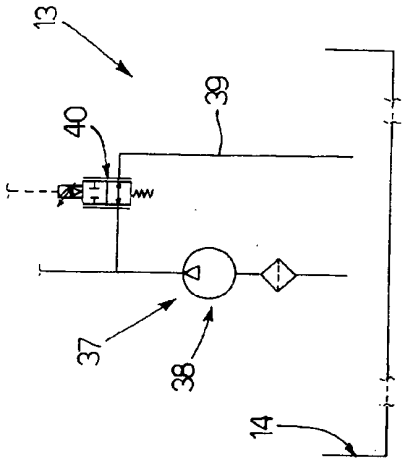

Fig.3

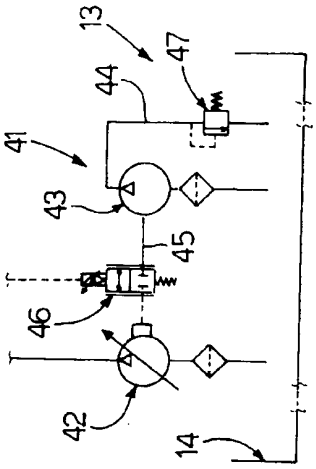

Fig.4

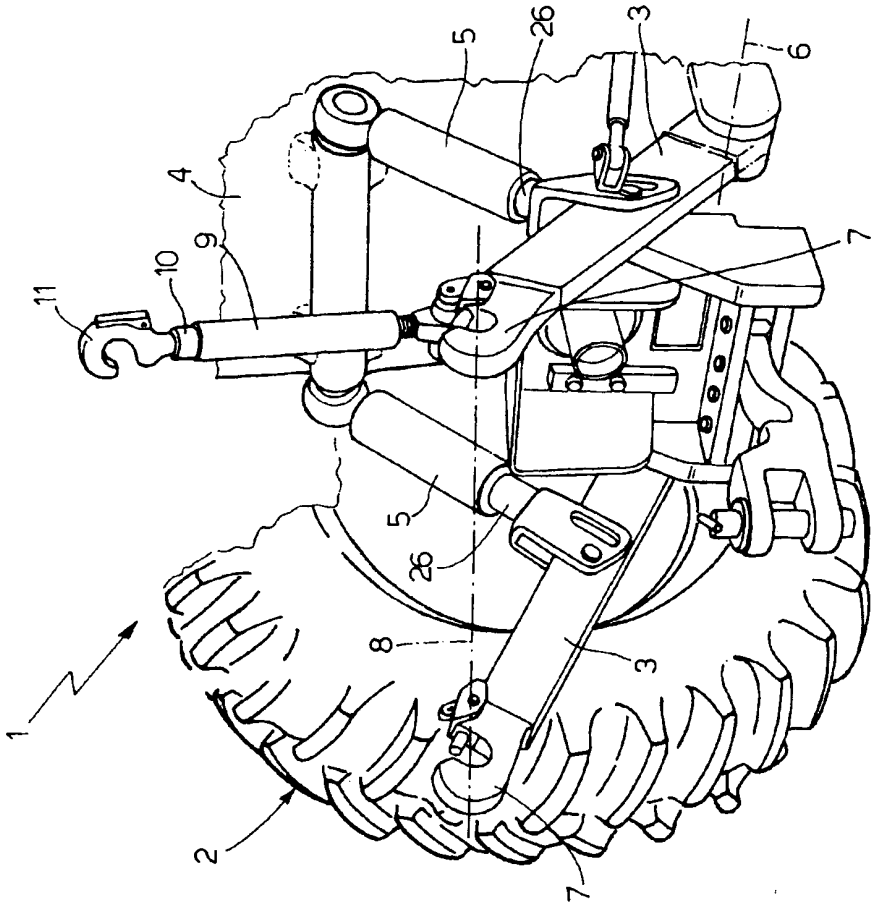

Fig.1

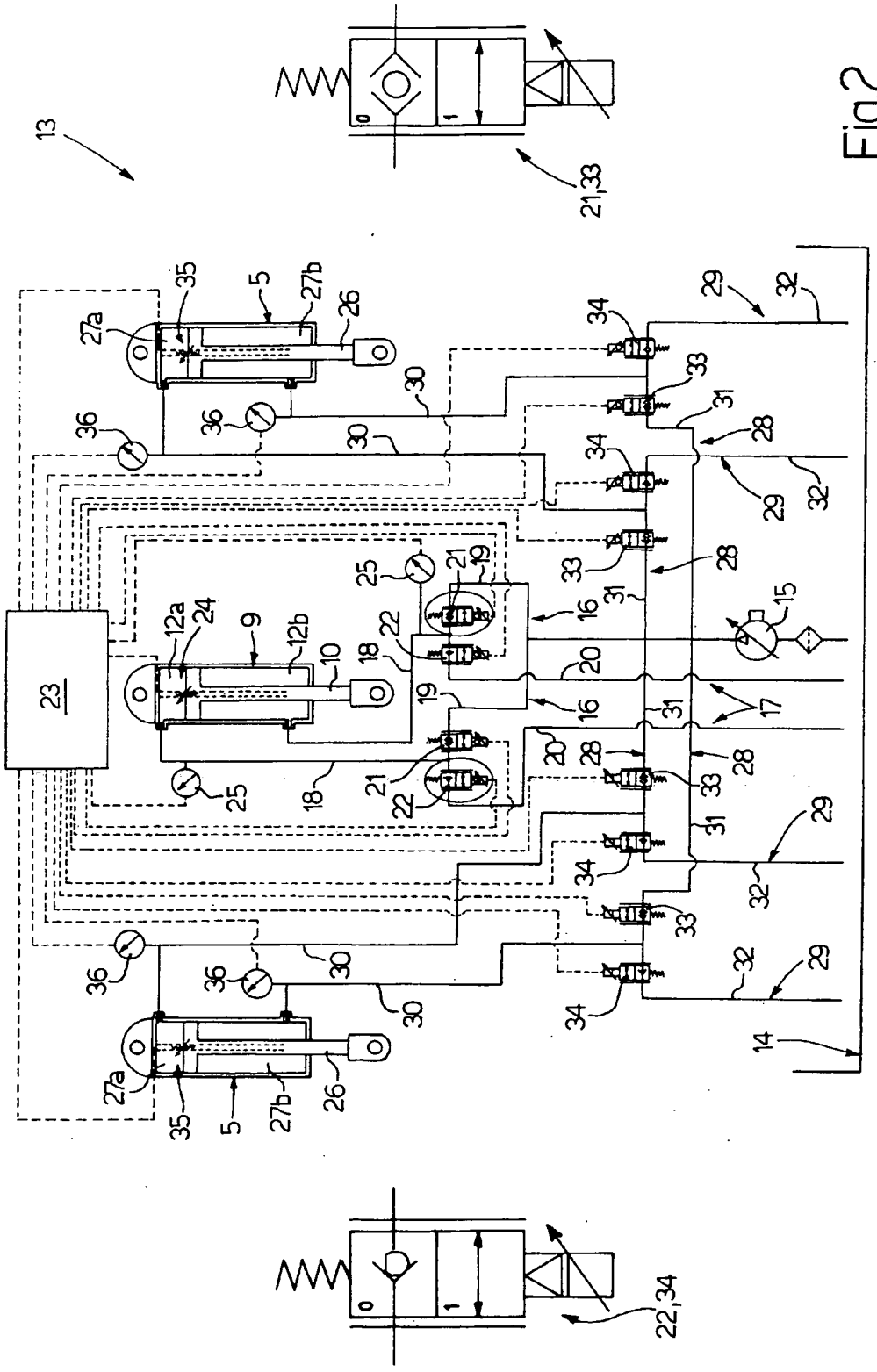

Fig.2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 10 3484

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	US 3 795 415 A (KOCH J ET AL) 5 March 1974 (1974-03-05) * figures 3,11 *	1,6,7, 12,13	B60D1/46 A01B63/112
Y	US 4 702 489 A (ERICKSON NORTON J) 27 October 1987 (1987-10-27) * figure 5 *	1,6,7, 12,13	
A	US 3 731 745 A (KOCH J) 8 May 1973 (1973-05-08) * figures 1,3 *		
A	US 2001/007399 A1 (JUNG HOLGER ET AL) 12 July 2001 (2001-07-12) * figures 1,2 *		

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B60D
A01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	6 November 2003	Dauvergne, B

CATEGORY OF CITED DOCUMENTS

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06-11-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3795415 A	05-03-1974	AR 209901 A1	15-06-1977
		AU 5444773 A	17-10-1974
		CA 986353 A1	30-03-1976
		CA 993256 A2	20-07-1976
		DE 2345523 A1	11-04-1974
		DE 2345524 A1	11-04-1974
		ES 418943 A1	01-03-1976
		ES 418947 A1	01-03-1976
		FR 2201024 A1	26-04-1974
		FR 2201025 A1	26-04-1974
		GB 1443831 A	28-07-1976
		GB 1438028 A	03-06-1976
		IL 42904 A	31-08-1976
		IL 43874 A	31-08-1976
		IT 994337 B	20-10-1975
		IT 994338 B	20-10-1975
		JP 49069408 A	05-07-1974
		SU 561488 A3	05-06-1977
		SU 502590 A3	05-02-1976
		US 3791454 A	12-02-1974
		ZA 7307649 A	28-08-1974
		ZA 7307650 A	28-08-1974
US 4702489 A	27-10-1987	CA 1269117 A1	15-05-1990
US 3731745 A	08-05-1973	AU 450168 B2	04-07-1974
		AU 4598072 A	28-02-1974
		CA 976413 A1	21-10-1975
		CA 978014 A2	18-11-1975
		DE 2301835 A1	09-08-1973
		ES 411042 A1	01-12-1975
		FR 2170054 A1	14-09-1973
		GB 1402804 A	13-08-1975
		IL 41314 A	10-02-1975
		IT 977097 B	10-09-1974
		JP 48085306 A	12-11-1973
		US 3834738 A	10-09-1974
		ZA 7300706 A	31-10-1973
US 2001007399 A1	12-07-2001	DE 19747949 A1	06-05-1999
		AT 409438 B	26-08-2002
		AT 151898 A	15-01-2002
		AU 708177 B2	29-07-1999
		AU 8958298 A	03-06-1999
		CA 2252440 C	09-04-2002
		FI 982349 A	01-05-1999

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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06-11-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2001007399 A1		FR 2770366 A1	07-05-1999
		GB 2330758 A ,B	05-05-1999
		IT MI982096 A1	30-03-2000
		IT 1302633 B1	29-09-2000
		US 6218737 B1	17-04-2001

EPO FORM P0459

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